this capacity is lower powered, it has a higher overhead protection of Rate 1/3 FEC and, therefore, is suitable for a mobile environment.

A summary of the FM auxiliary services capacity is as follows:

	Type (max kbps)				Total
Mode	Ancillary*	Opportunistic*	Supplementary	Secondary	Maximum
Hybrid	32	32	72	0	104
All-Digital	32	32	48	128	208

*The total of ancillary and opportunistic data cannot exceed 32 kbps

AM DAB System:

The AM system contains both ancillary services and opportunistic data. Because the bandwidth of the channel is much narrower than is the case for the FM system, supplementary and secondary services cannot be supported without violating the fundamental system requirements USADR has defined.

1. Ancillary Services: The channel supports up to 16 kbps by reducing the highest audio throughput from 48 kbps to 32 kbps. The ancillary rate can be set at an arbitrary rate up to 32 kbps with a corresponding reduction in audio rate.
2. Opportunistic Data: Opportunistic data can be transmitted to sporadic rates of 16 kbps. Some latency exists due to the nature of the audio being transmitted. The total (ancillary services plus opportunistic data) transmitted through the AM channel is limited to 16 kbps.

Appendix M

USADR Technical Partners

Xetron Corporation

Xetron Corporation was founded in 1972 with the vision of becoming a premier developer of sophisticated electronic communications systems. Through innovative solutions to the technological challenges facing the government and commercial markets, Xetron has established itself as a leader in providing world-class products and systems.

Through engineering excellence, Xetron has secured numerous patents in signal processing, filtering, and interference cancellation. Combining engineering expertise with a thorough understanding of the operational methods and requirements of the end user, Xetron consistently achieves a very high customer satisfaction rating. This has significantly contributed to Xetron's sustained growth.

In 1986, the Westinghouse Electric Corporation purchased Xetron to add Xetron's unique communications capabilities to that of its Electronic Systems Group, headquartered in Baltimore, Maryland. In March 1996, the Electronic Systems Group was acquired by the Northrop Grumman Corporation, and became the Electronic Sensors and Systems Division.

Xetron has supported USA Digital Radio's AM development efforts by providing design and consulting services, including software simulation models, hardware for test exciters and receivers (including interface specifications for AM transmitters), and support for test efforts. In addition, Xetron has conducted detailed studies of the AM broadcast band to characterize the interference environment of the AM band.

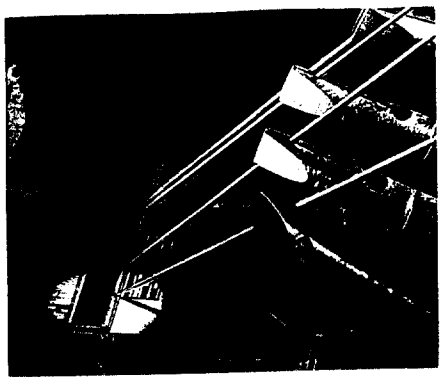
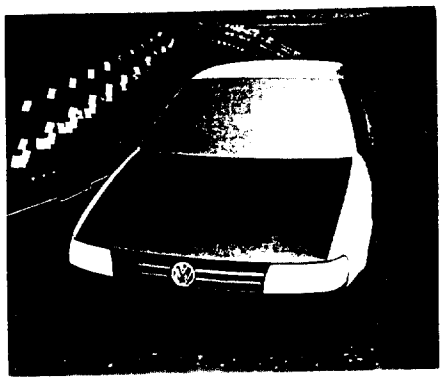
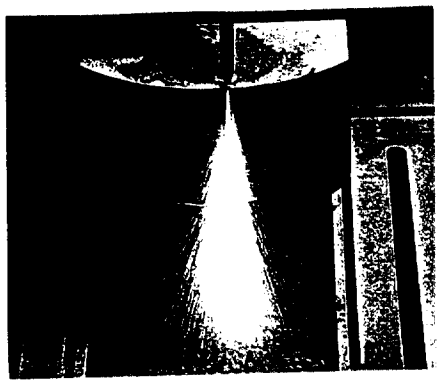
Xetron has conducted channel characterization tests for the USADR AM system with over the air evaluations at WNOP in Cincinnati, WNFT in Boston, and the Xetron experimental station also in Cincinnati.

Fraunhofer Institut für Integrierte Schaltungen

Fraunhofer Institut für Integrierte Schaltungen ("Fraunhofer IIS") is an institute within Fraunhofer-Gesellschaft, Germany's leading organization for applied research. Fraunhofer-Gesellschaft operates 47 research institutes in Germany and employs approximately 9,000 people.

Fraunhofer IIS is the world's leading research laboratory in the area of audio coding. Fraunhofer IIS has been a pioneer in the field of high quality, low bit rate audio compression technology and has been the leading developer of the most advanced audio coding schemes such as MPEG Layer-3 and MPEG Advanced Audio Coding ("MPEG AAC"). Fraunhofer IIS also plays a major role in the ongoing work for the standardization of MPEG 4.

Fraunhofer IIS has experience applying its audio coding expertise to the field of digital audio broadcasting. Fraunhofer IIS has worked with developers to design terrestrial and satellite based digital broadcasting systems according to developer requirements such as net data rate, coverage area, type of service, type of transmission (satellite or terrestrial) and type of reception (mobile or fixed). Fraunhofer IIS has also developed prototype system components (HW and SW) for validation and field tests as well as consumer-type terminals. Fraunhofer's services include: participation in the standardization processes, system verification, system development design and implementation of validation hardware, feasibility studies on implementation of systems and subsystems, design and manufacturing of equipment.

Fraunhofer International

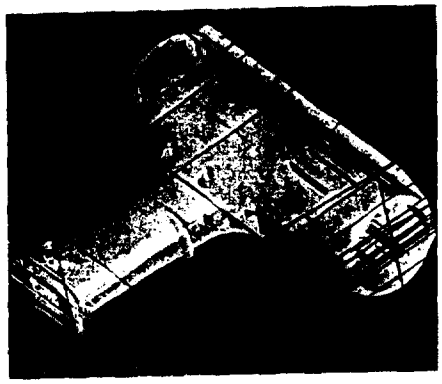
Advancing a Worldwide Partnership in Research and Development

FhG

Fraunhofer Gesellschaft

A profile of the Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft is Germany's leading organization for applied research. It operates 47 Institutes in Germany, 5 Research and Resource Centers in the US, and 3 Representative Offices in Asia. Around 8,800 people work for the Fraunhofer-Gesellschaft, which will have a 1996 budget of more than US $ 800 million. Over two-thirds of this budget is earned through contract research for industry and government.
Each year, the Fraunhofer-Gesellschaft provides its services to 2 000 customers worldwide.



Rapid Prototyping techniques enable rapid manufacturing of computer-generated components

Hans-Jürgen Warnecke
Professor of Manufacturing Technology, President of the Fraunhofer-Gesellschaft

The association's »guiding light«

The Fraunhofer-Gesellschaft was founded in Munich, Germany, in 1949. Joseph von Fraunhofer (1787–1826) was a researcher, inventor and successful entrepreneur. His achievements and ideas continue to serve as an example to the organization named after him.

A focus on industry and government

Demand for the research services of the Fraunhofer-Gesellschaft comes primarily from two sources: industry and government.
Most contracts from industry – for small and medium-sized enterprises as well as large corporations – involve tangible solutions to problems and applications or the evaluation and implementation of innovative technologies.
National and European funding programs allow strategic research to be conducted which is of interest to society at large. This involves concerns such as the rational use of energy, solutions to traffic and environmental problems, and the need to develop key technologies. Effective methods of technology transfer ensure that small and medium-sized companies gain rapid access to innovations.
Realizing that technologies of the future call for a long-term research strategy, the Fraunhofer-Gesellschaft uses its participation in national and international technology programs to test its expertise in the face of global competition and to increase its research capabilities through continuous efforts.

The Fraunhofer model puts market and performance factors first

In competition with other research institutions, the Fraunhofer-Gesellschaft earns around 70 percent of its revenue from contract research and projects acquired from industry, service companies and government.
30 percent of its revenue is institutional funding provided by the German government. This is reviewed each year and rises in accordance with the increased revenue acquired externally. This financial model is unique for a research establishment, and stimulates performance. The degree of success achieved is constantly determined by market forces.

What we can do for you

The Fraunhofer Institutes develop processes and methods as well as products for their customers, up to their introduction to the market. The service sector is gaining importance in this regard, in addition to the established demand from manufacturing industries. Contracts are carried out with the confidentiality that is expected from a reliable business partner. Collaboration takes place in carefully planned stages and can range from a one-day consultation to a major, internationally networked project. Services range from testing of developments and training of staff on company premises to comprehensive consultancy, feasibility studies, analysis of trends, calculations of economic viability, and eco-audits.

Contract research that gives you top quality and cost-effectiveness

Collaboration with the Fraunhofer Institutes and their numerous experts provides industrial partners with a wide spectrum of know-how and experience. A single contact puts the expertise of all 47 Institutes at the customer's disposal. Thus even the most complex questions can be addressed, and interdisciplinary system solutions developed. Uniform quality standards and professional project management ensure reliable and cost-effective completion of research contracts.

The research fields

The applied research conducted by the Fraunhofer-Gesellschaft has eight focal fields within the engineering and natural sciences.

- **Materials technology, component behavior**
This comprises the development of new materials such as ceramics, hard metals, metal foams, compound materials, inorganic-organic polymers, nano-crystalline powder, and wood materials, and the development of new coating materials and surface technologies. Work extends further to component development, characterization, testing and quality assurance.

- **Production technology**
Work focuses on the planning, simulation and automation of complex manufacturing processes, the conception and layout of flexible production facilities, logistics, quality assurance and machine-tool control systems, the »fractal company«, and Rapid Prototyping.

- **Information technology**
Focal fields include image processing and pattern recognition, visualization, interaction and communications technologies, control and automation technology with expert or fuzzy control systems, graphical data processing for multimedia and electronic publishing, telecommunications for computer-supported work, and improvements to the interfaces between operator and machine.

- **Microelectronics, microsystems technology**
Core activities are research into semiconductors for high and highest-level circuits on the basis of silicon and gallium arsenide, related production equipment, the development of digital, analogue and hybrid circuits, microsystems technology using integrated sensors, actuators, and related mounting and connection technology.

- **Sensor, testing and measurement technology**
Work includes non-destructive testing using ultrasound or electromagnetic resonance for applications in material testing and medicine, optical and acoustic processes of quality control, laser spectrometers, laser-optical and holographic measurement techniques, micro-optics and integrated optics.

- **Process engineering**
This research field comprises biotechnology, food packaging and environmental process technology, membrane and polymer technology with technical exploitation of regenerative raw materials, and the development of chemical energy sources.

- **Energy and construction technology, environmental and health technology**
Solar cells, collectors, power storage units and fuel cells are developed for the exploitation of solar power. Concepts and designs for low-energy houses aim to reduce energy consumption. Health research focuses on the toxic effects of environmental chemicals and pharmaceutical products. Ecotoxicological evaluation of chemicals and analysis of atmospheric pollution are aimed at improved environmental protection.

- **Technical and economic studies**
Interdisciplinary technological analyses, evaluations and forecasts serve to facilitate decision-making and long-term planning in industry and government.

The reasons behind our initiative in worldwide activities

First milestones

For science to play its part in finding solutions to the diversity of problems facing national and international economies, global networks and interdisciplinary approaches are imperative. Whereas in recent years the Fraunhofer-Gesellschaft focused attention on collaboration with European partners, it has now set itself the goal of extending its expertise across all national boundaries and into new fields of service in research.
Having recently opened Representative Offices in Kuala Lumpur, Singapore and Beijing and founded a subsidiary in the US, the Fraunhofer-Gesellschaft is now establishing Research and Resource Centers in which research groups are brought together to work directly within the region where they are needed. Five of these have already begun operation in the United States, and initial projects have been completed successfully with follow-on contracts. Similar models of cooperation are being considered in Southeast Asia and China. Further Centers are envisaged, which will be able to call on the expertise of the Institutes at home in Germany.

What we hope to gain from working in partnership

- New forms of global cooperation in science and engineering,
- New approaches to solutions in the development of national technology programs and related economic growth,
- Recognition and active promotion of global trends in science and technology,
- Identification of the needs of national markets and adaptation of the research services we offer accordingly,
- Participation in the establishment of an international science network, which will help to identify and solve problems existing on a global scale.

What we have to offer you

- Participation in international collaborative research projects,
- The experience and know-how of a large research organization,
- Use of the results of studies on global trends in technology, such as the Delphi Report on Technologies of the 21st Century,
- Consultancy at our Representative Offices, aimed at the promotion of the national economy through work in innovative technologies,
- Research and product development at 47 Institutes in Germany, and 5 Research and Resource Centers in the US,
- The capability to close gaps in national research know-how through our expertise and experience,
- Advice in the establishment of a research infrastructure responding to the needs and economic imperatives of the state or region.

Dr. Jürgen Rüttgers, the Federal German Minister of Education, Science, Research and Technology

»Who could be in a better position than the Fraunhofer-Gesellschaft to provide industry with multidisciplinary solutions to complex problems – networking its institutes in the search for innovative products?
I therefore heartily welcome the international commitment of the Fraunhofer-Gesellschaft. Its new initiative of founding a subsidiary in the United States, and opening representative offices in Asia will prove to be of great interest. Key innovations in the future will no longer be possible in any country in the world if a provincial approach is taken to research and its applications. Our system of science must therefore see itself – and act – as part of a global network of science and innovation.«

From his speech to the 1995 Annual General Meeting of the Fraunhofer-Gesellschaft in Brunswick